847,171 COMPLETE SPECIFICATION

5 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

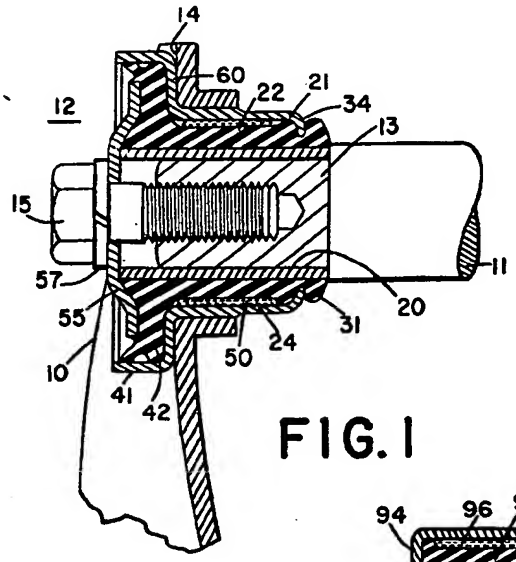


FIG. 1

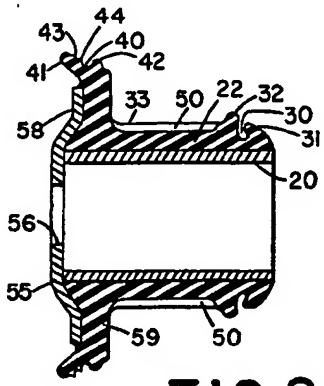


FIG. 2

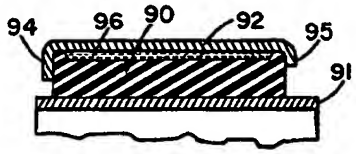


FIG. 9

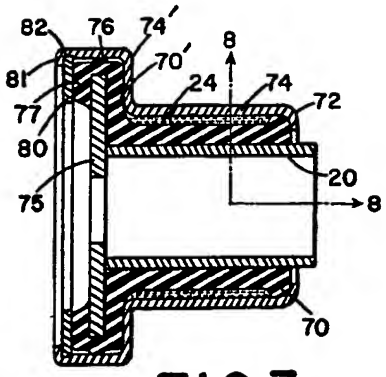


FIG. 3

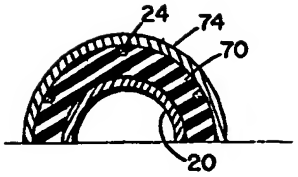


FIG. 8

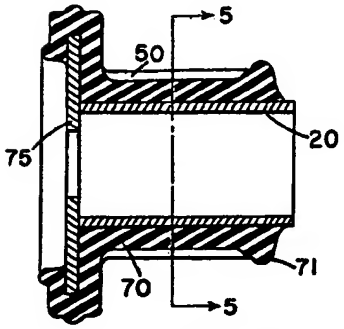


FIG. 4

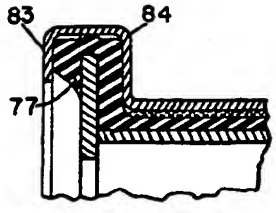


FIG. 7

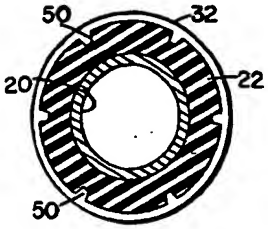


FIG. 5

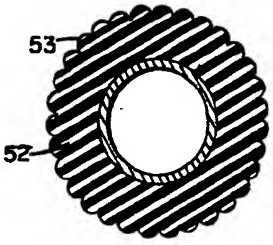


FIG. 6

847,171 COMPLETE SPECIFICATION

5 SHEETS This drawing is a reproduction
the Original on a reduced sca
SHEETS 2 & 3

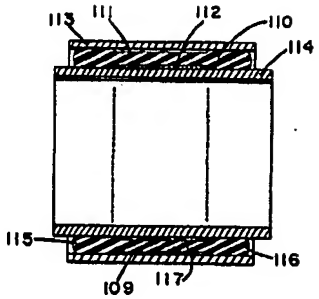


FIG.11

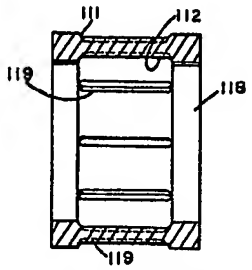


FIG.12

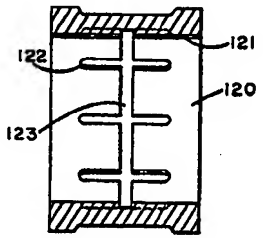


FIG.13

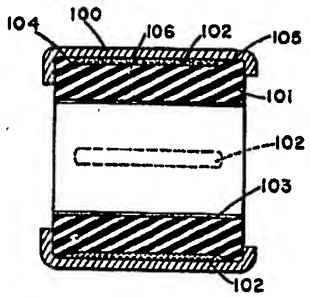


FIG.10

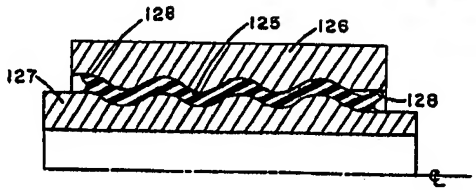


FIG.14

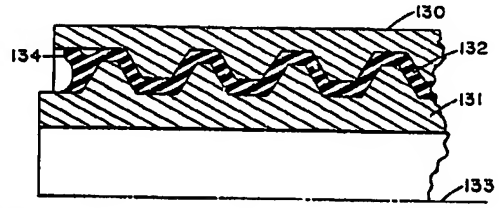


FIG. 15

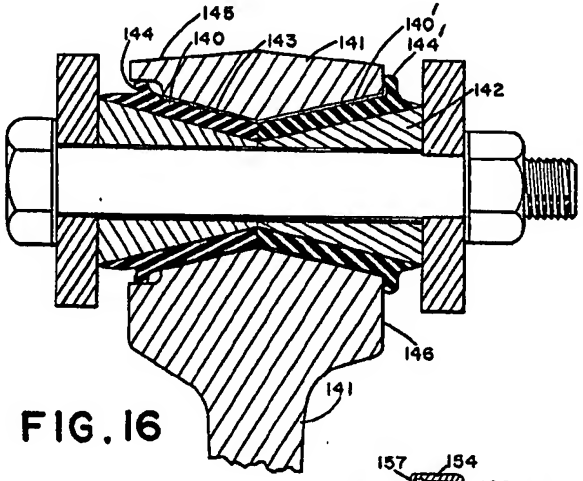


FIG. 16

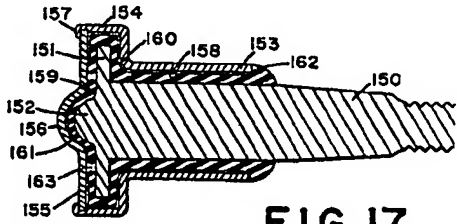


FIG. 17

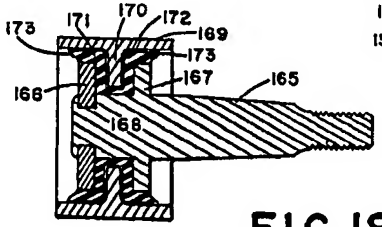


FIG. 18

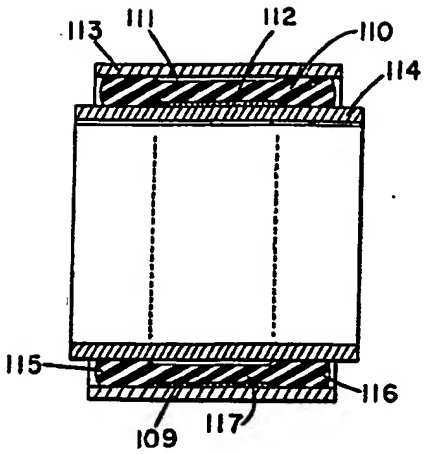


FIG.11

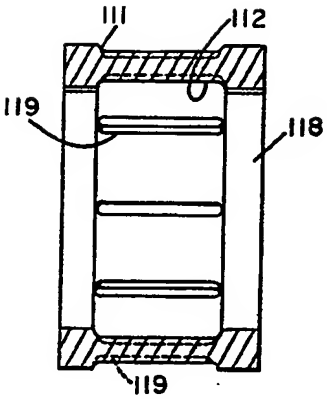
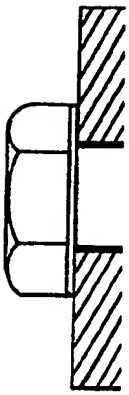


FIG.12



FIG

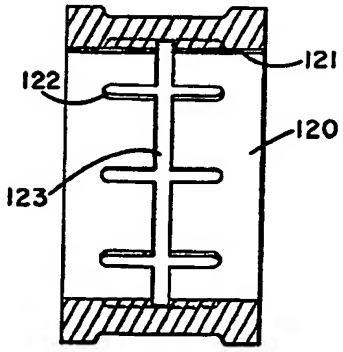


FIG.13

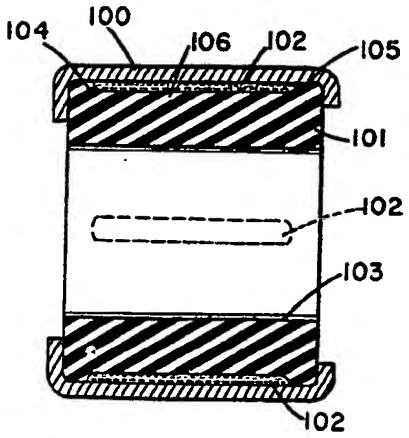


FIG.10

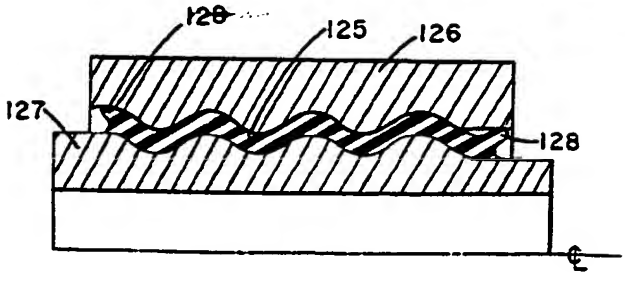
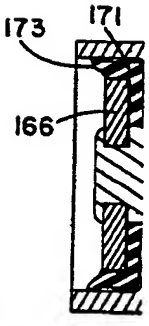


FIG.14



847,171 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

SHEETS 2 & 3

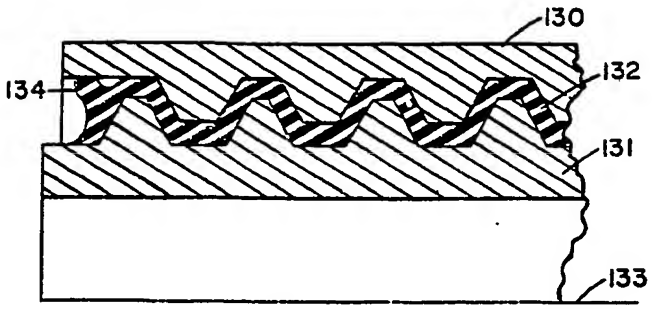


FIG. 15

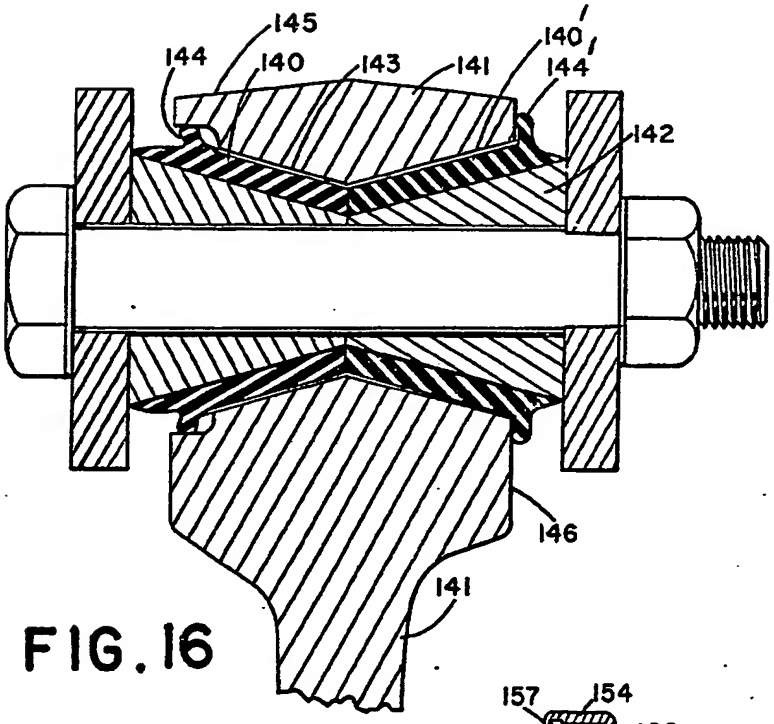


FIG. 16

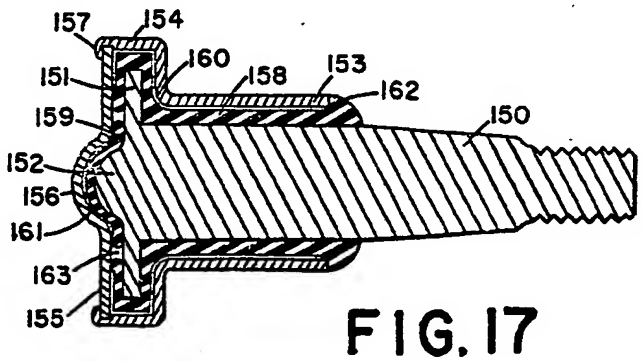


FIG. 17

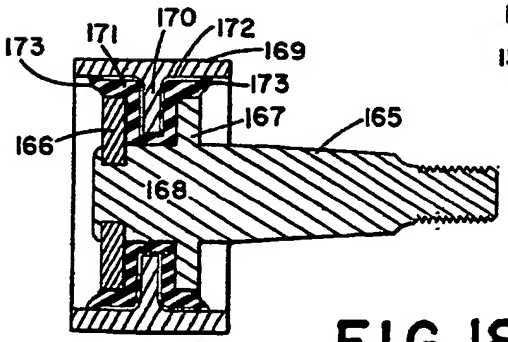


FIG. 18

847,171 COMPLETE SPECIFICATION

5 SHEETS This drawing is a reproduction o the Original on a reduced scale. SHEETS 4 & 5

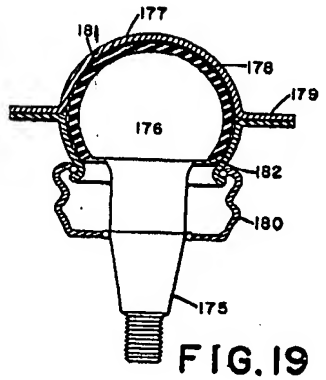


FIG. 19

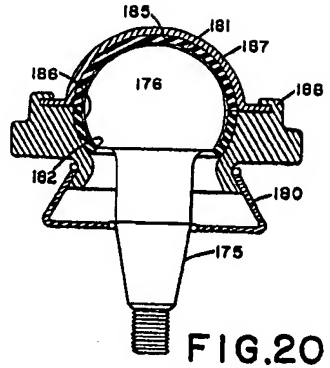


FIG. 20

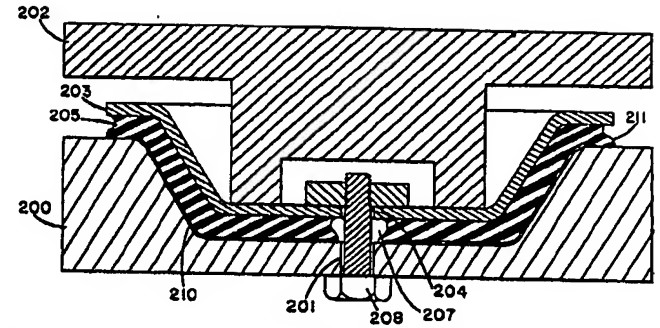


FIG. 24

FIG. 25

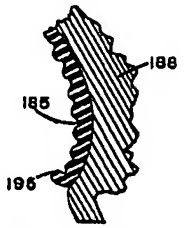


FIG. 22

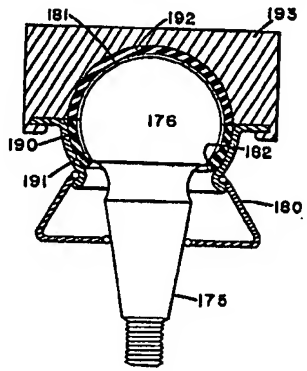


FIG. 21

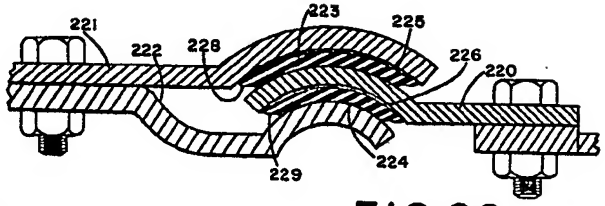


FIG. 26

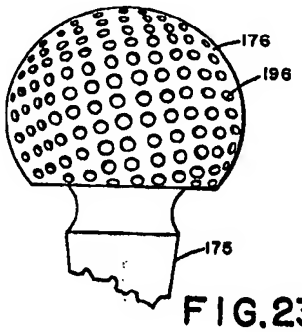


FIG. 23

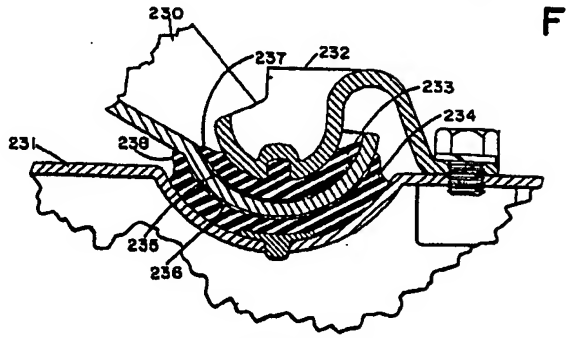


FIG. 27

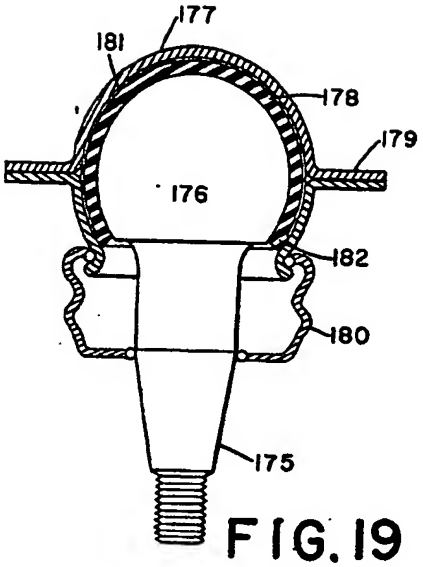


FIG. 19

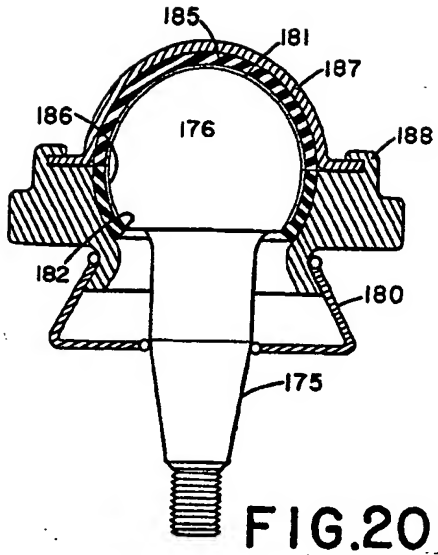


FIG. 20

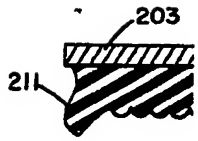


FIG. 2

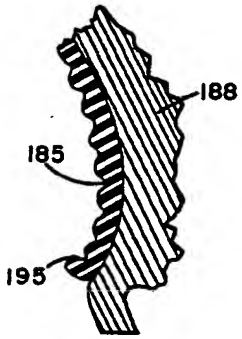


FIG. 22

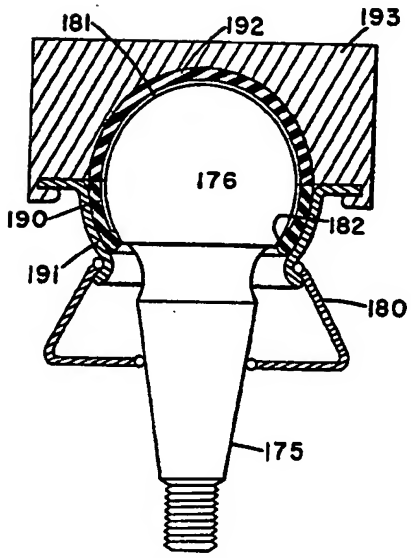


FIG. 21

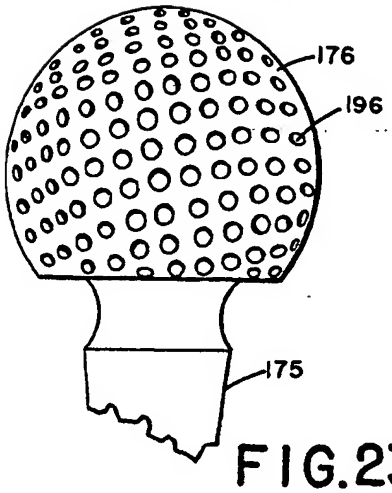
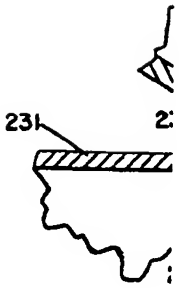


FIG. 23



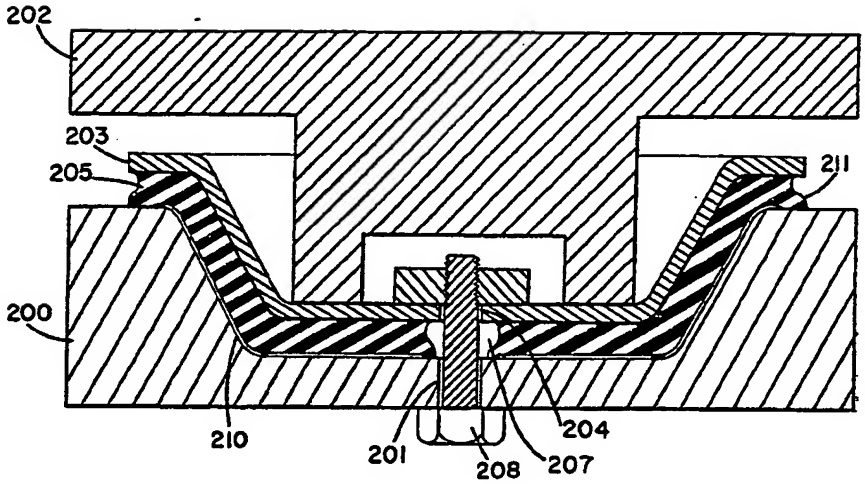


FIG. 24

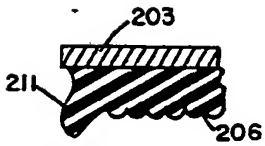


FIG. 25

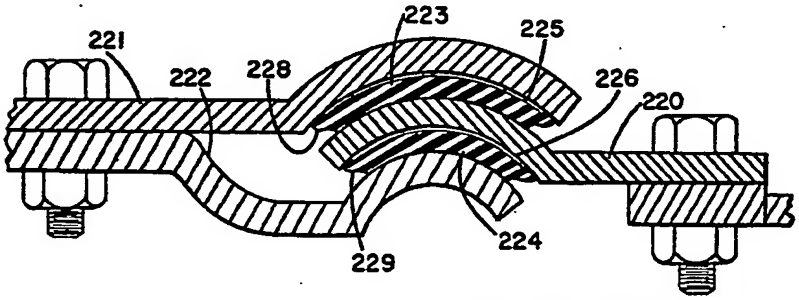


FIG. 26

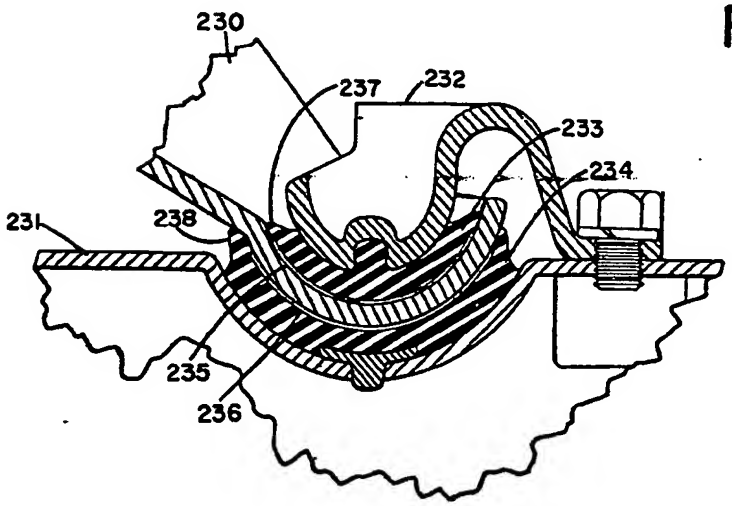


FIG. 27

PATENT SPECIFICATION

DRAWINGS ATTACHED

847171

Date of Application and filing Complete Specification: June 9, 1958. No.18387/58.

Application made in United States of America on Nov. 27, 1957.

Application made in United States of America on June 11, 1957.

Complete Specification Published: Sept. 7, 1960.

Index at Acceptance:- Class 65(2), F1(B:G:K2C:T1), F3(C1:CX:D1:E:F).

International Classification:- F06c, f.

COMPLETE SPECIFICATION

Permanently Lubricated Rubber Bearing

We, CLEVITE HARRIS PRODUCTS INC., a Corporation existing under the Laws of the State of Ohio, United States of America, of 6545 Carnegie Avenue, Cleveland 3, Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention pertains to a lubricated rubber bearing wherein the lubricant is permanently retained within the bearing. The term "rubber" is to be understood to include natural rubber and synthetic rubber-like elastomers.

In the past rubber bearings and bushings have been made consisting of two concentric, spaced-apart metal sleeves with rubber between the two sleeves in such a manner that relative rotary motion between the sleeves caused shear in the rubber. The rubber was bonded to both of the sleeves or adhered to them by either a chemical bond or a frictional bond, or by a combination of the two bonds. Units having a high frictional bond or adherence often used a temporary lubricating material during assembly when the rubber sleeve was "shot" into the metal sleeves. Almost all of this temporary lubricating material was squeezed out during assembly and the remainder of the lubricant was absorbed by the rubber within a short period of time, resulting in a device which had the desired high frictional forces or adherence between the rubber and the sleeves when it was put to its intended use.

Bearings and bushings made with these techniques have been successfully used extensively in automotive construction, especially in front suspension control arm pivot joints, shock absorber pivotal joints, steering linkage bushings, rear suspension linkage bushings, and the like.

The aforedescribed rubber bearings have inherent torsional spring-rate characteristics, evidenced by the fact that if either of the two sleeves was rotated torsionally with respect to the other sleeve, forces would build up in the rubber which would try to return the sleeves to their original positions, and this has created problems and limitations in designing automobile chassis linkages for particular ride qualities.

The present invention has applications in many fields but is particularly applicable for use in automobile chassis linkages.

According to one aspect of the invention a bearing assembly includes a rigid element for attachment to one of the members to be connected by the bearing assembly, a co-operating rubber-like element for attachment to the other of such members, adjacent surfaces of such elements constituting relatively movable bearing surfaces, and a lubricant located between and permanently sealed against escape from between such surfaces.

According to a further aspect of the invention a bearing assembly includes two rigid elements for attachment respectively to two members to be connected by the bearing assembly, a rubber-like element positioned between and having surfaces adjacent to and co-operating with the respective rigid elements, and a lubricant located between and permanently sealed against escape from between at least one of the sets of adjacent surfaces, which lubricated adjacent surfaces constituting relatively movable bearing surfaces.

Preferably a recess is formed between the lubricated adjacent surfaces to form

a reservoir for lubricant, the recess for example comprising a groove in the lubricated surfaces of the rubber portion. Conveniently, a permanent seal is provided by co-operating parts of the two elements situated along the boundary or boundaries of the adjacent lubricated surfaces.

In some forms of the invention the lubricated adjacent surfaces are part spherical surfaces while in some other forms the lubricated adjacent surfaces are cylindrical surfaces.

In a form including two rigid elements for attachment respectively to two members to be connected by the bearing assembly and in which the surfaces of the rubber-like element adjacent to the two rigid members are cylindrical surfaces, at least one of the rigid members may be provided with one or more radially extending parts arranged to resist axial movement of such rigid member relatively to the rubber element, one set of adjacent surfaces of the rubber-like element and one of the rigid members may be lubricated and constitute relatively movable bearing surfaces, and the other set of adjacent surfaces of the rubber-like element and the other rigid member may be bonded together.

The invention may be put into practice in various ways and a number of bearing assemblies will now be described by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a longitudinal cross-sectional view of a lubricated rubber bearing in a typical mounting;

Figure 2 is a sectional view of a portion of the unit with the outer metal tube removed;

Figure 3 is a longitudinal cross-sectional view of a modified form of the invention particularly adapted to resist thrust in two directions;

Figure 4 is a sectional view of a portion of the unit shown in Figure 3;

Figure 5 is a sectional view taken along lines 5-5 of Figure 4;

Figure 6 is a sectional view showing a modified type of lubricant retaining groove;

Figure 7 is a fragmentary view showing a modified form of the device shown in Figures 3 and 4;

Figure 8 is a sectional view taken along line 8-8 of Figure 3;

Figure 9 is a sectional view showing a modified form of the invention;

Figure 10 shows a very simple type of bearing incorporating the features of this invention;

Figure 11 is a longitudinal sectional view through a modified type of lubricated bearing having a fixed, low spring rate;

Figures 12 and 13 are modified types of rubber-like inserts for the device shown in Figure 11;

Figure 14 shows by a sectional view a portion of a device wherein the rubber-like element is in the form of a screw thread;

Figure 15 is a sectional view of a portion of a device wherein the rubber-like element is corrugated in cross section;

Figure 16 is a sectional view showing the principle of the invention applied to a doubly tapered bushing;

Figure 17 is a sectional view of an end-thrust device embodying the invention;

Figure 18 is a sectional view of a device for taking thrust in two directions and embodying the invention;

Figures 19, 20, and 21 show the inventive principle applied to ball joints of several types;

Figure 22 shows a detail of the seal used with the ball joints of Figures 20 and 21;

Figure 23 shows the surface of the ball modified to provide a different kind of recess for the lubricating material;

Figure 24 shows by a sectional view a device for supporting heavy vertical loads as for railroad suspensions or fifth wheels for trucks;

Figure 25 is a fragmentary view of the natural shape of the sealing portion of the rubber-like material;

Figure 26 shows by a sectional view the principle of the invention applied to a pivotal joint; and

Figure 27 shows the invention applied to another form of pivotal joint.

The permanently lubricated rubber bearing of the present invention is shown in Figure 1 mounted to connect and form a pivotal joint between the upper control arm 10 and the control arm shaft 11 in a typical automotive suspension installation.

The bearing unit, identified by reference character 12, is hollow and fits around a reduced end portion 13 of the control arm shaft 11, and by a force fit is held in close engagement with a shoulder 14 of the upper control arm 10. The reduced end portion 13 of the control arm shaft 11 is bored and threaded, and a bolt 15 extends into the bearing unit 12 into threaded engagement with the control arm shaft 11, thereby locking the bearing unit in place.

The bearing unit 12 must be hollow

for the application shown in the drawing, but for other applications this is not essential. As shown, the bearing is comprised of a hollow inner sleeve member 20 preferably formed of metal and a concentric hollow outer sleeve member 21 also preferably formed of metal. A rubber sleeve 22 is mounted between the concentric metal sleeves 20, 21, and is secured to only one of the sleeves to prevent relative rotary motion between the rubber sleeve and the one metal sleeve to which it is secured. In the device shown the rubber sleeve 22 is bonded or otherwise affixed to the inner metal sleeve 20.

A lubricant 24 is positioned between the outer surface of the rubber sleeve 22 and the inner surface of the metal sleeve 21 to provide for permanently lubricating the area of contact between the rubber sleeve 22 and the outer metal sleeve 21. Upon the application of a torsional force being applied to the outer sleeve 21 the built-in permanent lubricant causes the outer sleeve 21 to slip relative to the rubber sleeve 22 with very low frictional resistance, and since there is substantially no distortion in the rubber as the slippage takes place, there is no spring force built up in the rubber urging the unit to spring back to its original position. In other words, due to the lubrication and slippage the unit has no torsional spring rate.

Sealing means are provided at each end of the bearing to prevent the escape of the permanent lubricant and to prevent dirt from working into the lubricated area. The sealing means shown in Figures 1-4 are located between the rubber sleeve 22 and the outer metal sleeve 21, and there is one at each end of the unit. The sealing means at the right-hand end of the unit is comprised of the annular groove 30, the upwardly and inwardly extending lip 31 at one side of the groove 30, and the bead 32 which extends around the unit above the level of the lubricated surface 33. The end 34 of the outer metal sleeve 21 turns inwardly into the groove 30 and the bead 32 is in close contact with the inside surface of the sleeve 21. The inwardly extending lip 31 engages the outer surface of the inwardly turned end 34 and establishes a seal which prevents the entry of dirt and which helps to prevent the escape of the lubricant. At the other end of the unit the sealing means comprise a groove 40, an upwardly extending lip 41 and a bead 42, as shown in Figure 2. The lip 41 has two sharply pointed annular ridges 43, 44 establishing point contact with the metal sleeve to increase local pressure between the rubber sleeve 22 and metal sleeve 21 without establishing high frictional forces therebetween. When assembled, as shown in Figure 1, the bead 42 is in close engagement with the inside surface of a portion of the outer sleeve member 21, and the sharp annular ridges on the upwardly extending lip 44 are in resilient contact with the inside surface of the sleeve 21 establishing oil and dirt seals. Thus, the unit shown in Figures 1 and 2 has at each end a double seal. It is to be understood, however, that either one of the seals could be used by itself.

To assure a supply of lubricant within the unit, a plurality of grooves 50 are provided around the circumference of the rubber sleeve 22. When assembled, these grooves 50 contain a supply of lubricant, and as relative motion takes place between the outer metal sleeve 21 and the rubber sleeve 22 the lubricant is continuously applied to a wide area of contact between the slipping parts. Where a lubricant reservoir is not needed the grooves 50 may be omitted.

The particular lubricant used should be chosen to be dependent upon the type of rubber-like material used. The lubricant should not react chemically with the rubber nor with the metal with which it comes in contact. Also, the lubricant should not be absorbed by the rubber throughout the life of the bearing, and it should act as a proper lubricant throughout the range of ambient temperatures expected in service.

Examples of lubricants suitable for use with natural and reclaimed rubber are: silicone, Carbowax, castor oil, and Ucon 50 HB.

When the elastomer is styrene butadiene rubber (GRS), recommended lubricants are silicone, Carbowax, or Ucon 50 HB.

When the elastomer is a nitrile rubber such as Hycar (Registered Trade Mark) or the like, recommended lubricants include polybutene, petrolatum and silicone.

For neoprene rubber the recommended lubricants are polybutene, petrolatum, silicone and castor oil. For butyl rubber it is recommended that silicone, Ucon 50 HB or castor oil be used.

For a silicone type elastomer Ucon 50 HB or Carbowax may be used.

"Carbowax" is a trade name for polyethylene glycol.

"Ucon 50 HB" is a Registered Trade Mark for a brand of polyalkylene glycols

and their derivatives.

"Neoprene" is a chloroprene rubber.

The lubricant should be able to flow, that is, it should have no elastic limit. Materials such as nylon, teflon (Registered Trade Mark), etc., having elastic limits, are not suitable for the purposes of this invention.

The rubber-like material should not absorb the lubricant, nor should it be porous because as the pores become stopped up with dirt adequate lubrication is lost.

A washer 55 having a bolt hole 56 is supplied as a part of the bearing unit to facilitate assembly of the unit between the control arm 10 and the control arm shaft 11. The washer 55 is concentric with the hollow sleeve 20 and the hole 56 accommodates the assembly bolt 15. A lock washer 57 may be used. The washer 55 has a flange portion 58 which extends radially outwardly and whose inner face is bonded to a flange portion 59 of the rubber sleeve 22. Thus, the bearing unit as sold may comprise the rubber sleeve 22, the inner and outer sleeves 20, 21 only one of which is bonded to the rubber sleeve, and the end washer 55 bonded to the rubber.

For installation as shown in Figure 1 it is required that the unit be able to resist axial thrust in one direction. This is achieved by the provision of the flange 59 in the rubber sleeve 22, and by having a radially extending flange portion 60 in the outer metal sleeve 22. One face of the rubber flange 59 lies against the flange 60 of the sleeve 21 and the other face against the washer 55. The outer diameter of the washer 55 is appreciably greater than the inner diameter of the flange 60 of the sleeve 22 so that there is established an overlap between the washer 55 and the flange 60. Axial motion between the washer 55 and the outer sleeve 22 tending to move them toward each other will be resisted by compression of the rubber therebetween.

Figures 3 and 4 show a lubricated rubber bearing adapted to take thrust in two directions. The rubber sleeve member 70, shown in Figure 4, terminates in a sealing bead 71, and when assembled, as shown in Figure 3, the downwardly turned end 72 of the metal sleeve member 74 overlaps the bead 71 establishing the lubricant and dirt seal at one end of the unit. Only a single seal is shown at each end of this unit, but it is to be understood that a double seal, as shown in Figure 1, could also be used. Figure 5 shows a sectional view of the bearing taken along line 5-5 of Figure 4.

At the opposite end of the unit a washed 75 is bonded to the rubber member 70, and it extends radially outwardly, as previously explained, into an overlapping position with respect to the radial portion 74' of the outer metal sleeve 74, with a radial portion 70' of the rubber member 70 positioned therebetween. The annular rubber flange 70' has a peripheral portion 76 and has a reverse or reentrant portion 77 integral therewith extending radially inwardly toward the inner sleeve member 20. A thrust collar 80 is held against the outside face of the reentrant portion 77 by the outside sleeve member 74 which has an inwardly turned lip 81 having a notch 82 in its inner diameter in which the collar 80 is positioned. Thrust in either direction between the inner and outer sleeves 20, 74 will be transmitted to the portion of the rubber sleeve 70 on one side or the other of the washer 75.

In the device shown in Figure 6 the rubber member 52 has a plurality of scallops on its outside surface, forming a plurality of lubricant retaining grooves to facilitate the even distribution of lubricant to the walls of the metal member with which it is to be assembled.

Figure 7 shows a modified form of device for resisting axial thrust, wherein one end 83 of the outer metal sleeve 84 is folded inwardly on the reentrant portion 77 of rubber sleeve 70, thus obviating the thrust collar 80 shown in the device of Figure 3.

Figure 9 shows still another modified form of the invention wherein a rubber sleeve 90 is chemically or frictionally bonded to an inner metal sleeve 91, and an outer metal sleeve 92 is positioned around the rubber sleeve 90. The ends 94 and 95 of the outer metal sleeve extend around the ends of the rubber sleeve 90 to hold the unit together and to seal in the permanent lubricant in the groove 96 of the rubber sleeve 90. With the sleeve ends 94, 95 folded around the rubber sleeve 90 the unit will take limited thrust in either direction axially. As shown, the sleeve end 94 folds around the rubber sleeve to a greater extent than does the end 95. This permits the unit to be assembled by funneling the rubber sleeve 90 into the preformed outer metal sleeve 92 for rapid assembly.

Figure 10 shows a very simple, inexpensive form of the invention having a small, fixed amount of spring rate. In this embodiment there are only three separate physical elements needed to form a permanently lubricated bearing of excellent characteristics

and life. They are a housing portion 100, a rubber portion 101, and permanent lubricating material 102 trapped in a plurality of spaced locations between the housing 100 and the rubber portion 101. There does not need to be an inner housing member within the bore 103 of the rubber member 101 as the purchaser, such as the auto manufacturer, may supply this portion. Also, the unit as sold may have the housing member which cooperates with the rubber-like member to contain the lubricant located within the bore instead of outside of the member as illustrated.

The sealing portions at the edges between the housing 100 and the rubber-like member 101 may be of the type shown in Figures 1, 2, 3, 4, 7 and 8, or, as illustrated in Figure 10, the end seals may be constituted by rubber portions 104, 105 whose thickness in an unassembled condition is sufficiently greater than the thickness of the intermediate portion 106 to establish, when assembled, compressive forces on portions 104, 105 sufficient to frictionally bond the surface at locations 104, 105 to the inside surface of the housing 100 and thus to seal the lubricant within the space located between the housing 100 and the central portion 106 of the rubber-like material. Such a construction results in a bearing having a spring rate which is very low compared to previous bearings wherein the rubber was compressed between two members, and because of the novel application of the permanent lubricant between the ends 104, 105 the combined frictional and torsional forces against turning are quite small. The space for the lubricant 102 may be in the form of grooves running axially of the rubber member 106, or the groove can run circumferentially around the member 106. In such a construction the load bearing capacity of the bearing is considerable since the areas of the end portions 104, 105 are always in contact with the inner face of the housing 100 for the transfer of light to moderate loads. However, when a heavy load occurs radially of the unit slightly increased area of the rubber-like material comes into contact with the inside face of the housing, with a consequent squeezing action which expels the lubricant 102 from the grooves aligned in the direction of the load. This lubricating material flows between the rubber-like material and the housing to locations 90 degrees around the unit from the loaded top and bottom portions, thereby lubricating the load transmitting surfaces. Thus, for a bearing unit which has changing load forces applied to it, there is a continuous pumping action which continuously forces the lubricant across the load bearing faces.

Under the shaking that road irregularities create in the car, the radial loads on the various blocks vary all the time at such a frequency that such pumping action is intense and continuous flow of silicone or similar lubricant is forced between the surfaces at the very spots where needed.

This principle of forced permanent lubrication is applicable to all of the bearing units herein described, and for maximum pumping action it is desirable that all of the spaces between the rubber-like members and their housings be substantially filled with the permanent lubricating material.

Figures 11, 12 and 13 show other variations in the bearing of the present invention. Reference character 110 represents a rubber-like member having one or more grooves 111, 112 extending completely around its outside diameter face and around the inside diameter face. An outer housing 113 is provided, and inside the rubber-like member 110 there is an inside housing member 114. In the embodiment shown in Figure 11 the rubber-like member 110 is adapted to slip with respect to both housing members 113 and 114, but it is to be understood that the invention may be practiced by having the member 110 slip with respect to only one of the housing members, in which event the only groove needed is the one between the rubber member and the housing with respect to which it is to slip. Also, it is within the scope of the invention to have the user of the device supply one or the other of the housing members, as was explained in connection with Figure 10.

Only the end portions 115, 116 of the rubber-like member 110 are normally under compression in the assembled device, the center portion 117 being free from compression except when heavy loads are applied across the bearing. In this event the area of the rubber-like member in contact with the housing members is suddenly greatly increased, thereby enabling the bearing unit to handle heavy loads. The end portions 115, 116 are always under compression, thereby, as in Figure 10, sealing the lubricant 109 inside the grooves 111, 112 and to a certain small degree giving to the bearing a determinable small amount of spring rate which in many applications is desirable. The amount of spring rate designed into the unit

is a function of the degree of compression of the end portions 115, 116 of the rubber-like member, the area of the end portions in permanent engagement with the housing members and the qualities of the rubber-like material.

Figure 12 shows a modified form for the rubber-like member. In addition to having shallow grooves 111, 112 extending around its exterior and interior faces the member 118 has separate lubricant storage grooves 119 in its inner and/or outer faces.

In the embodiment shown in Figure 13 the rubber-like member 120 has a smooth bore 121 except for the horizontal lubricant storage grooves 122 which are connected together by an annular groove 123.

Figure 14 shows a rubber-like member 125 between two housings 126, 127; the inner faces of the housing portions being in the form of a screw thread and being spaced apart from each other with the rubber-like member being positioned between them. Grooves or dimples may be located in either or both of the inner faces of the housing members, or the grooves or dimples may be in either or both of the faces of the rubber-like member 125 to accommodate a permanent lubricant, and sealing means 128 are provided at either end of the member 125 to seal the lubricant in place.

Figure 15 shows a device somewhat similar to the device shown in Figure 14, except that the two housing members 130, 131 have corrugated threads rather than screw threads, and consequently either the inner or outer housing member 130, 131 or both, should be split along the center-line 133 to facilitate assembly of the unit. As in the previously described unit permanent lubricant is located in grooves or dimples between the corrugated rubber-like member 132 and either one or both of the housing members, and sealing means 134 are provided at the edge surfaces to seal the lubricant in place. Splitting along the center line 133 can be avoided by using a threaded joint as shown by Canadian Patent 499,449, to Decourdemanche.

Figure 16 shows the invention applied to a tapered bushing, the two tapered rubber-like members 140, 140' being located between the arm 141 and the core 142. As shown, lubricant grooves 143 preferably along generatrixes of the cones are provided between the rubber-like members and the arm 141, and two different types of sealing means 144, 144' are provided at the edges for retaining the permanent lubricating material in the grooves 143. Seal 144 acts against the underneath surface of an overhang 145, and seal 144 acts against the edge surface 146 of the arm 141.

Figure 17 shows the invention embodied in a unit capable of taking end thrust, such as for rod end bearings. The unit comprises the threaded rod 150 having an integral end ball 152. The housing around the unit comprises a tubular portion 153 having an enlarged portion 154, and an end plate 155 having a centrally located spherical portion 156. The end 157 of the enlarged portion 154 is turned over to hold the end plate 155. A first rubber-like member 158 is located between the tubular housing 153 and the rod 150, and a second rubber-like member 159 is located between the end ball 152 and the spherical portion 156 of the end plate 155. Space 163 is provided between the two rubber members 158, 159 to allow for displacement of the rubber during assembly and during operation, and also to accommodate a supply of lubricating material. It is within the scope of the invention to make rubber members 158, 159 in a single piece, in which event corrugations or oil grooves should be provided to accommodate rubber displacement. As shown, a plurality of lubricant grooves full of lubricating material 160 are provided between the housing 153, 154 and the rubber-like member 158 to facilitate the turning of the rod 150 with respect to the housing, and a lubricant groove 161 is provided between the rubber-like member 159 and the spherical portion 156 of the end plate 155. Sealing means 162 are provided between the rod 150 and the end of the housing 153 to retain the lubricant within the unit. During continuous operation of the unit over long periods of time, heat may tend to expand the rubber member causing undue internal pressure. The rubber member, being discontinuous, has space 163 to accommodate the enlargement, thereby keeping the internal pressure down to a reasonable amount.

Figure 18 shows a modified type of unit capable of taking end thrust, wherein the rod 165 has integral with it, or connected to it, two collars 166, 167 spaced apart by the intermediate portion 168 of the rod. The tubular housing 169 has an inwardly extending annular collar 170 located midway between the two collars 166, 167, and a rubber-like member 171 is positioned between the housing 169 and the rod 165, and extends around the annular collar 170 in such a manner to position a thick layer of the rubber-like material

between the housing and the rod. Spaced apart lubricant containing grooves 172 are provided, preferably located between the rubber-like member 171 and the housing to facilitate the relative rotation of the rod and housing members, and sealing means 173 are provided at the edges where the rubber-like member engages the housing 169 to assure that the lubricant will permanently be retained within the sealed unit.

The embodiments of the inventions shown in the first 18 figures of this specification are all sleeve bearings of one form or another. As illustrated, the rubber member may be secured by friction or by bonding to one or the other of the metal members, but it will be appreciated that in some forms of the invention the rubber member may be substantially free from tight engagement with both metal members so that relative motion takes place between the rubber member and both metal members. Further, the lubricant seals may be separate members distinct from the rubber bearing member. Thus at the ends of the sleeve units rubber "O" rings may be used of sufficient size that they are positioned and held between the two metal sleeves with sufficient pressure to prevent escape of the permanent lubricating material within the unit. Furthermore, throughout the description of the sleeve bearings there has been shown and described scallops and grooves in the surface of the rubber member which is to slip with respect to a metal member. It is to be understood that any other physical configuration which will cause the retention of lubricating material may be used. Thus the surface of the rubber unit may contain a plurality of dimples, or it may have a number of raised areas between which the lubricating material may be stored. Also, the lubrication retaining configurations may be in the surface of the metal member instead of in the surface of the rubber member.

Figures 19 to 23 show the principle of the invention applied to various types of ball joints.

In Figure 19 there is shown a threaded rod 175 having a ball 176 at one end. Around the ball 176 is a two-part spherical housing 177, spaced from the ball 176, and with a rubber-like member 178 therein. The two-part housing is secured together after assembly around the ball and rubber-like material by welding, bolting or otherwise connecting together the flanges 179, and a sealing device 180 is secured around the lower end of the housing and around the rod 175 to exclude dirt etc. Lubricant-containing grooves 181 are provided on the outer surface of the rubber-like member 178, and when the unit is assembled permanent lubricating material fills the grooves 181. Sealing means are provided at the edge of the rubber-like material 178 for retaining the lubricant. The rubber-like material 178 may be bonded to the surface of the ball 176, or as shown in Figure 20 the rubber-like material 185, 186 may be in two parts bonded respectively to the two housing parts 187, 188 and the lubricant grooves 181 may be in the rubber-like material adjacent the surface of the ball 176.

Figure 21 shows a ball joint wherein the rubber-like material is in two parts with one part 190 bonded to the housing member 191, and with the other part 192 frictionally bonded to the housing member 193.

In the devices shown in Figures 20, 21 where two-part rubber-like members are used the lubricating groove in the two parts preferably should be aligned with each other to facilitate the movements of the lubricating material within the unit.

Figure 22 shows an enlarged detail of the seal 182 in its uncompressed state prior to assembly of the unit. A simple and inexpensive way to provide the seal is to have the edge portions 195 of the rubber-like material of substantially greater thickness than the remainder of the rubber-like material. Upon assembly this portion is compressed between the ball member 176 and the adjacent portion of the housing thereby establishing around the base of the ball a zone of high pressure rubber which prevents the lubricant from leaking out of the sealed unit. Also, as shown in Figure 22, the inner surface of the rubber member may be scalloped to establish a plurality of lubricant retaining depressions 185.

While it is desirable for either the inner face or the outer face or both faces of the rubber-like member to contain the lubricant receiving grooves or dimples, it is also within the scope of the invention for the outer face of the ball 176 to have grooves or to have dimples 196 as shown in Figure 23 for the reception of permanent lubricating material.

Figure 24 shows the invention applied to a load suspension system such as would be used in railway cars, fifth wheels for trucks, etc., and comprises a support member 200 which is cup-shaped and which has through it a bolt hole 201.

The device 202 to be supported is carried by the cup-shaped member 203 which nests in the cup-shaped support member 200. A bolt hole 204 extends through the bottom of the cup-shaped member 203. A rubber-like member 205 is positioned between and is in engagement with the cup-shaped members 200, 203, and has through it the bolt hole 207 registering with bolt holes 201, 204, and a bolt 208 holds the cup-shaped members together. The rubber-like member 205 has one or more grooves 210 in its underneath surface for holding permanent lubricating material to facilitate the relative rotation of the two cup-shaped members 200, 203 with low coefficient of friction and with resistance to sideways thrust in all directions. Sealing means 211 are provided around the entire circumferential edge of the rubber-like member.

Figure 25 shows the shape of the sealing means 211 prior to its assembly into the device shown in Figure 24, and it also shows that a multiplicity of grooves 206 may be provided for even distribution of lubricant.

Figures 26 and 27 show the invention applied to pivotal joints.

In Figure 26 it is desired that the arm 220 pivot relative to the arms 221, 222. Two rubber-like members 223, 224 are utilized; the member 223 preferably being bonded to the upper surface of the arm 220 and the member 224 preferably being bonded to the upper surface of the arm 222. The upper surfaces of the two rubber-like members 223, 224 are grooved at 225, 226 respectively for the reception of permanent lubricating material. Sealing means 228 and 229 are provided around the circumferential edges of each of the members 223, 224.

Figure 27 shows a slightly modified version of the pivotal joint wherein it is desired that the arm 230 pivot relative to arms 231, 232. In this configuration the rubber-like member 233 is bonded to the arm 232 and the rubber-like member 234 is either bonded to the arm 231 or is held with respect to it by dry friction. The surfaces of the two rubber-like members 233, 234 facing the arm 230 are grooved at 235, 236 for the reception of permanent lubricant material and edge seals 237, 238 similar to that shown in Figure 25 are provided around the edges of the two members 233, 234.

WHAT WE CLAIM IS:-

1. A bearing assembly including a rigid element for attachment to one of the members to be connected by the bearing assembly, a co-operating rubber-like element for attachment to the other of such members, adjacent surfaces of such elements constituting relatively movable bearing surfaces, and a lubricant located between and permanently sealed against escape from between such surfaces.

2. A bearing assembly including two rigid elements for attachment respectively to two members to be connected by the bearing assembly, a rubber-like element positioned between and having surfaces adjacent to and co-operating with the respective rigid elements, and a lubricant located between and permanently sealed against escape from between at least one of the sets of adjacent surfaces, which lubricated adjacent surfaces constituting relatively movable bearing surfaces.

3. A bearing assembly as claimed in Claim 1 or Claim 2 wherein a recess is formed between the lubricated adjacent surfaces to form a reservoir for lubricant.

4. A bearing assembly as claimed in Claim 3 wherein the recess consists of a groove in the lubricated surface of the rubber portion.

5. A bearing assembly as claimed in Claim 1, Claim 2, Claim 3, or Claim 4, wherein the permanent seal is provided by co-operating parts of the two elements situated along the boundary or boundaries of the adjacent lubricated surfaces.

6. A bearing assembly as claimed in any one of Claims 1 to 5 wherein the lubricated adjacent surfaces are cylindrical surfaces.

7. A bearing assembly as claimed in any of Claims 1 to 5 wherein the lubricated adjacent surfaces are part spherical.

8. A bearing assembly as claimed in Claim 2 with any one of Claims 3 to 6, wherein the surfaces of the rubber-like element adjacent to the two rigid members are cylindrical surfaces and wherein at least one of the rigid members is provided with one or more radially extending parts arranged to resist axial movement of such rigid member relatively to the rubber element.

9. A bearing assembly as claimed in Claim 2 wherein a set of adjacent surfaces of the rubber-like element and one of the rigid members are lubricated and constitute relatively movable bearing surfaces, and a set of adjacent surfaces of the rubber-like element and the other rigid member are bonded together.

10. A bearing assembly as claimed in Claim 2 or Claim 9 wherein the rubber-like element is discontinuous.

11. A bearing assembly substantially as hereinbefore described with reference to Figures 1 and 2, or Figures 3, 4, 5 and 8, or Figures 3, 4, 5, 7 and 8, or Figure 9, or Figure 10, or Figure 11, or Figures 11 and 12, or Figures 11 and 13, or with reference to any one of Figures 14 to 21, or any one of Figures 24, 26 and 27.

KILBURN & STRODE,

Agents for the Applicants.

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PATENT ACT, 1949

SPECIFICATION NO. 847,171

In accordance with the Decision of the Superintending Examiner, acting for the Comptroller-General, dated the fourteenth day of February, 1961, this Specification has been amended under Section 29 in the following manner:-

Page 1, lines 72, 83, page 3, line 17, page 8, lines 68 and 79, *before* "lubricant" *insert* "liquid or semi-liquid"

Page 1, *after* line 74 *insert*:-

"By the term "liquid or semi-liquid lubricant" is to be understood a lubricating substance which will flow within the space within which it is located, with dimensional changes in such space."

Page 3, lines 109, 113, 119, 122 and 123, *after* "silicone" *insert* "lubricant"

Page 4, *delete* lines 3 to 8 inclusive

Attention is also directed to the following printer's error:-

Page 4, line 67, *before* "75" *for* "washed" *read* "washer"

THE PATENT OFFICE,
31st March, 1961

DS 91477/1(5)/R.153 200 3/61 PL